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BY
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GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

**INSTRUMENTATION AND FLIGHT
REPORT FOR AEROBEE 150
FLIGHTS 4.122 CG AND 4.123 CG**

by
W. D. Fortney

**National Aeronautics and Space Administration
Goddard Space Flight Center**

SUMMARY

This report is one of a series issued by GSFC's Sounding Rocket Instrumentation Section. Pertinent engineering information is contained concerning the instrumentation, telemetry, experiment and flight results of Aerobee payloads 4.122 CG and 4.123 CG.

Scientific objectives of these payloads were to collect data on celestial X-ray sources, the data to yield flux levels over a range from 0.1 to 15 Angstroms, locate sources of celestial X-rays, and measure the angular sizes of the X-ray sources.

Intention of this report is to illustrate the function and performance of instrumentation and telemeter equipment supplied by GSFC's Sounding Rocket Instrumentation Section, no analysis of either scientific data or vehicle performance is presented.

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INSTRUMENTATION AND FLIGHT REPORT ON AEROBEE 150 FLIGHTS 4.122 CG and 4.123 CG

INTRODUCTION

This report describes the function of NASA/GSFC's Sounding Rocket Instrumentation Section, in support of Aerobee 150 flights 4.122 CG and 4.123 CG. These flights were launched on 29 August and 27 October 1964, respectively, from the Aerobee launch facility at White Sands Missile Range, New Mexico (WSMR).

Primary objectives of the experimental section of the payloads were to collect data on celestial X-ray sources. These data were to yield (1) flux levels over a range from 0.1 to 15 Angstroms, (2) locate sources of celestial X-rays, and (3) measure the angular sizes of the X-ray sources.

RESPONSIBILITIES

Following the initiation of flight requirements to GSFC by American Science and Engineering, Inc. (ASE), a pre-shoot conference was held at GSFC's Beltsville building. One purpose of this conference was to establish the responsibilities of the Sounding Rocket Branch in support of the ASE X-ray payloads. Personnel from the Sounding Rocket Instrumentation Section, which is part of GSFC's Sounding Rocket Branch, attended this conference. The conference was culminated with Sounding Rocket Instrumentation Section charged with the responsibility of designing, fabricating, building-up, and testing two complete telemeter systems and support instrumentation. In addition to this commitment, personnel were also to be supplied to support the launchings at WSMR.

PERSONNEL

American Science and Engineering, Inc. was represented by Drs. H. Gursky, D. Frincklund, and R. Giacconi, who were the experimenters on the celestial X-ray payloads. Aiding the ASE experimenters were W. D. Fortney, Instrumentation Engineer, and J. Vaughn and J. Brock, Payload Technicians, all from GSFC's Sounding Rocket Instrumentation Section. The Range Project Engineer at WSMR was Cdr. Hatten.

PAYLOAD

Figure 1 illustrates the configuration of Flights 4.122 CG and 4.123 CG. Each payload consisted of a fiberglass Aerobee ogive nose cone, modified to incorporate three doors. These doors, ejected during flight, provided the experimental instruments with a view of space, from which they accomplished their scientific mission.

Each payload consisted of an 87.8-inch fiberglass nose cone, a 6-inch instrumentation extension, and a 14.8-inch parachute recovery package. (For a description of the recovery package, see Report No. X-671-64-303, Aerobee Parachute Recovery Pack Modifications.)

Instrumentation, mounted in the sustainer's regulator and tail can sections, were connected through shroud lines, which were mounted to the sustainer and connected at each end (See Figure 1).

EXPERIMENT

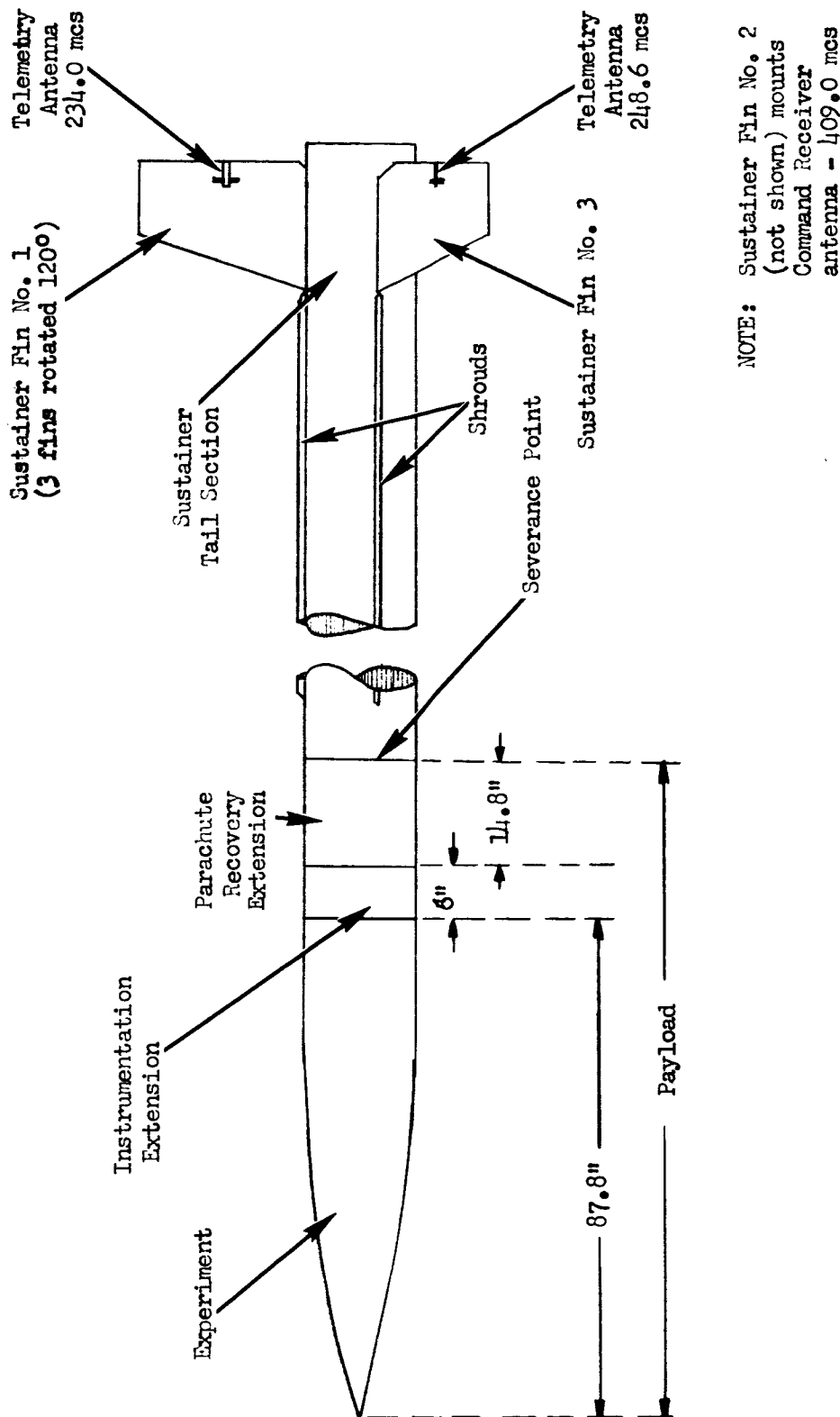
The experiment consisted of four independent banks of geiger counters, a photoelectric detector, two independent scintillation counters, and a star sensor. Figures 2 through 4 illustrate some of the experimentation.

Geiger counters were disposed at different elevation angles to provide almost full-sky coverage and were shielded by a common scintillation counter to eliminate cosmic rays.

The photoelectric detector flown in these payloads is a prototype of an instrument to be flown on OSO-D and consisted of an X-ray sensitive photocathode viewed by an electron multiplier. Evacuation of the detector was maintained by a self-contained getter ion pump, which operated prior to flight.

Scintillation counters, one using a thin sodium iodide crystal and the other a thin anthracene crystal, were used to measure the X-ray flux between 2 and 0.1 Angstrom and the low energy electron flux. Pulses were transmitted directly, with their amplitudes preserved, via the telemeter systems.

Star sensor optics consisted of a three-inch Fresnel lens that formed an image on the cathodes of a photomultiplier. Field of view of this device was $1.5^\circ \times 10^\circ$.



NOTE: Sustainer Fin No. 2
(not shown) mounts
Command Receiver
antenna - 409.0 mcs

Figure 1 - Mechanical Configuration of Flights 4.122 CG and 4.123 CG

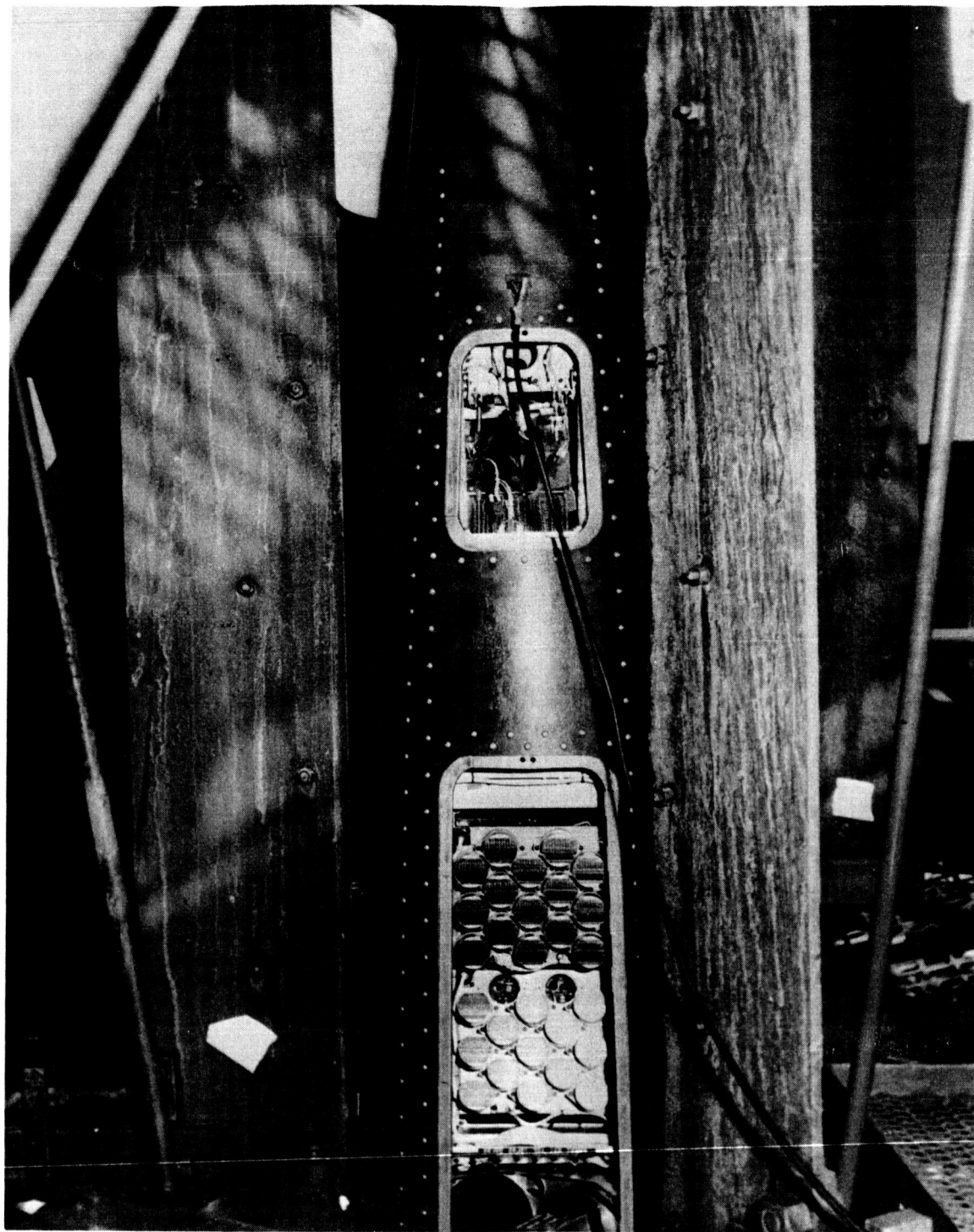


Figure 2 - Nose Cone Experimentation

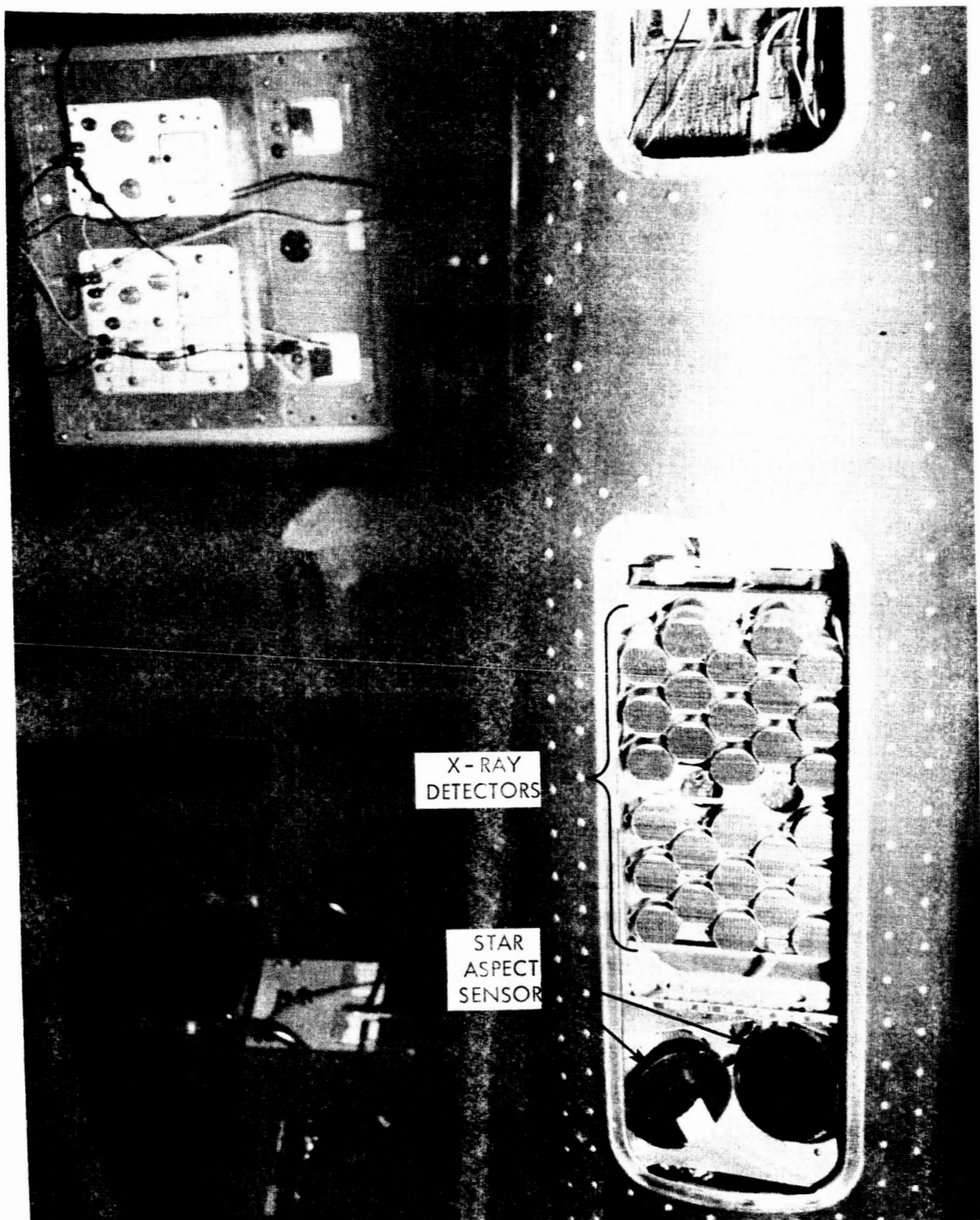


Figure 3 - Two Experiments Aboard Flight 4.123 CG

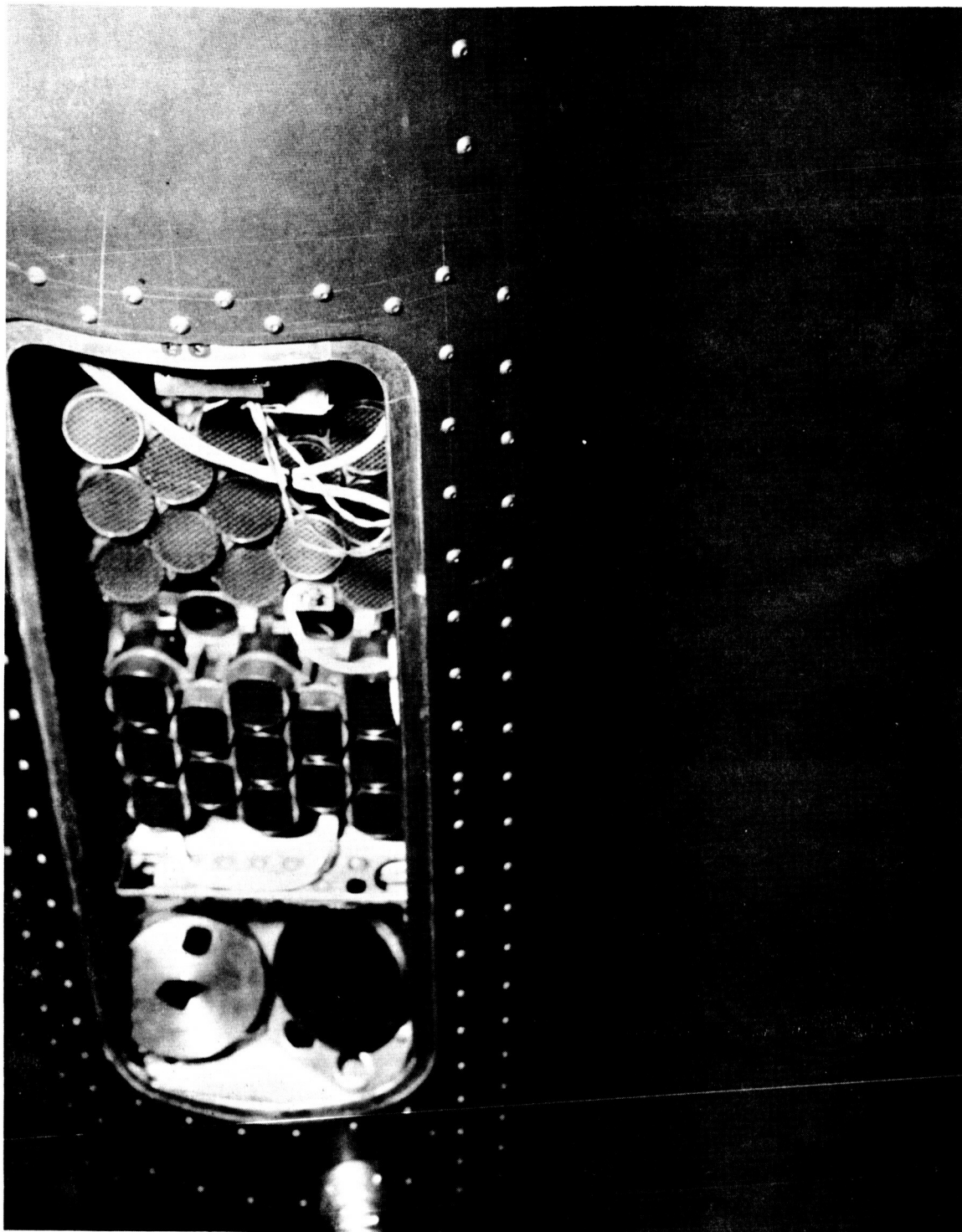


Figure 4 - Close-up View of X-ray Detectors and Star Aspect Sensors

INSTRUMENTATION

Sounding Rocket Instrumentation Section's Engineer, W. D. Fortney, was assigned the responsibility of designing an instrumentation system to support the ASE payload. Instrumentation systems consist of (1) telemeter system(s), as required, to transmit experiment and performance data, and (2) performance transducers to measure Aerobee vehicle performance during flight and other support instrumentation. The instrumentation system for these Aerobee payloads were housed in the instrumentation extension (see Figure 5), the regulator section, and the tail can section. Data, gathered from the performance transducers, provide housekeeping information on a continuing file of Aerobee rocket performance, and includes such information as acceleration, magnetic aspect, and chamber pressure. In addition to the design of a complete instrumentation system, the Instrumentation Engineer was also required to design, fabricate, and provide at the launch facility, a launch control ground console and a pullaway umbilical system.

Telemeter Systems

The instrumentation system designed (see Figure 6) was composed of two FM telemeter systems for each payload. One telemeter system, designated as telemeter no. 1, consisted of eight subcarrier, voltage-controlled oscillators (VCO's); a mixer amplifier; a voltage regulator; and an FM transmitter which was modulated on a carrier frequency of 234.0 mc/s. The second telemeter system, designated as telemeter no. 2, consisted of seven VCO's, a mixer amplifier, a voltage regulator, and an FM transmitter modulating on a carrier frequency of 248.6 mc/s. Figures 7 and 8 functionally illustrate telemeter systems 1 and 2 respectively.

Experiment and housekeeping data were hard-wired to an in-flight calibrator, the output of which modulated the VCO's of both telemeter systems. Table 1 provides a list of VCO allocations for both telemeter systems used on each payload. Calibrator outputs were applied to the VCO's, which were then modulated. Modulated outputs of each VCO were simultaneously applied to the mixer amplifier for that telemeter system, resulting in a composite output to modulate the FM transmitter.

Each telemeter system utilized three wide-band, standard IRIG VCO's, which were designated as bands E, C, and A. These VCO's provided greater frequency response for the experimental function of the aspect sensor, scintillator, and one geiger counter. Wide-band, standard IRIG VCO's are modulated on center frequencies of 70 kcs, 40 kcs, and 22 kcs respectively, with a frequency deviation of $\pm 15\%$ each. These

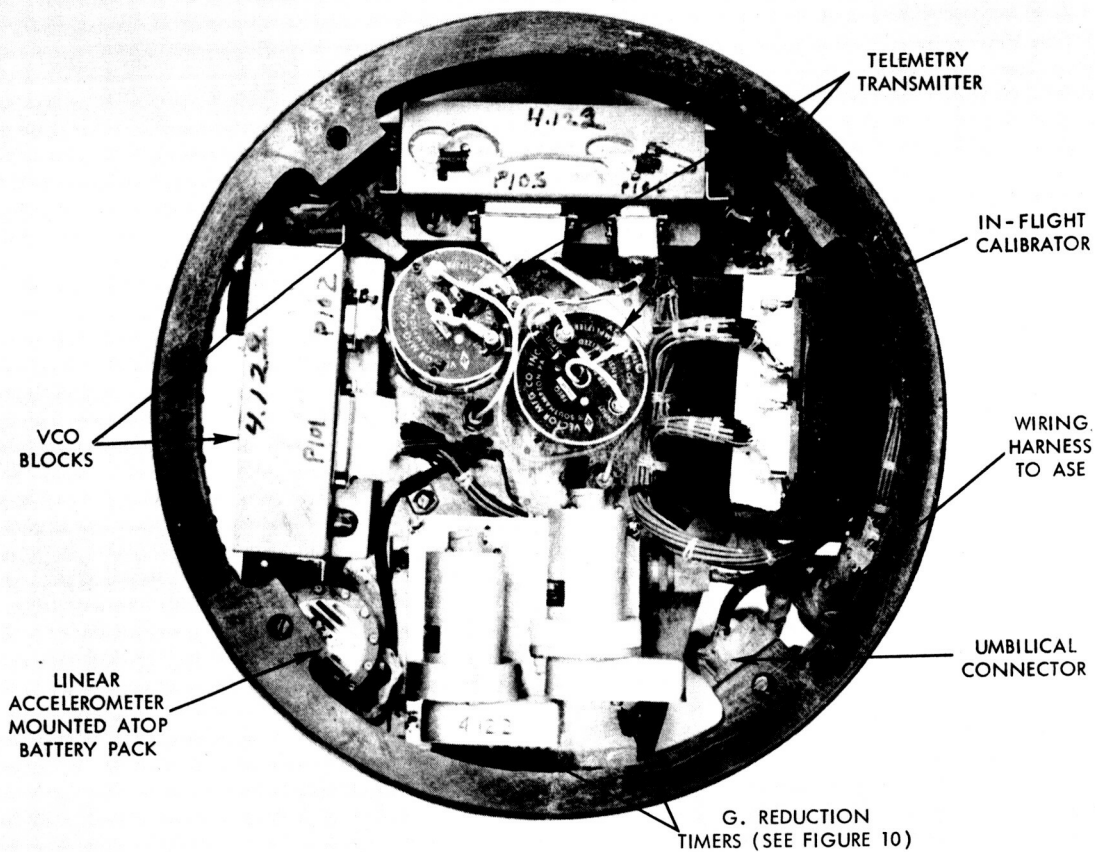


Figure 5 - Flight 4.122 CG Instrumentation Extension

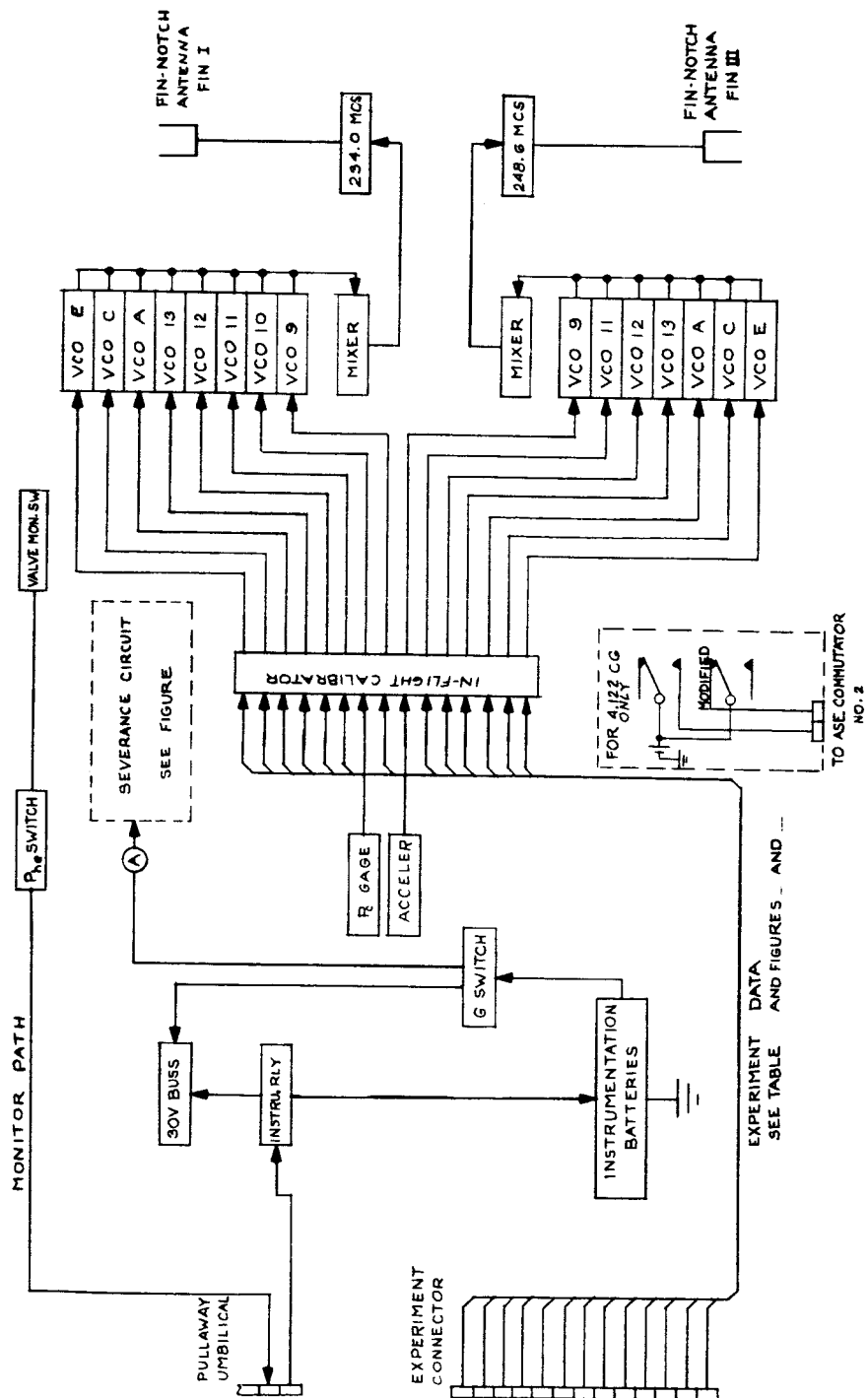


Figure 6 - Instrumentation and Telemetry System Block Diagram

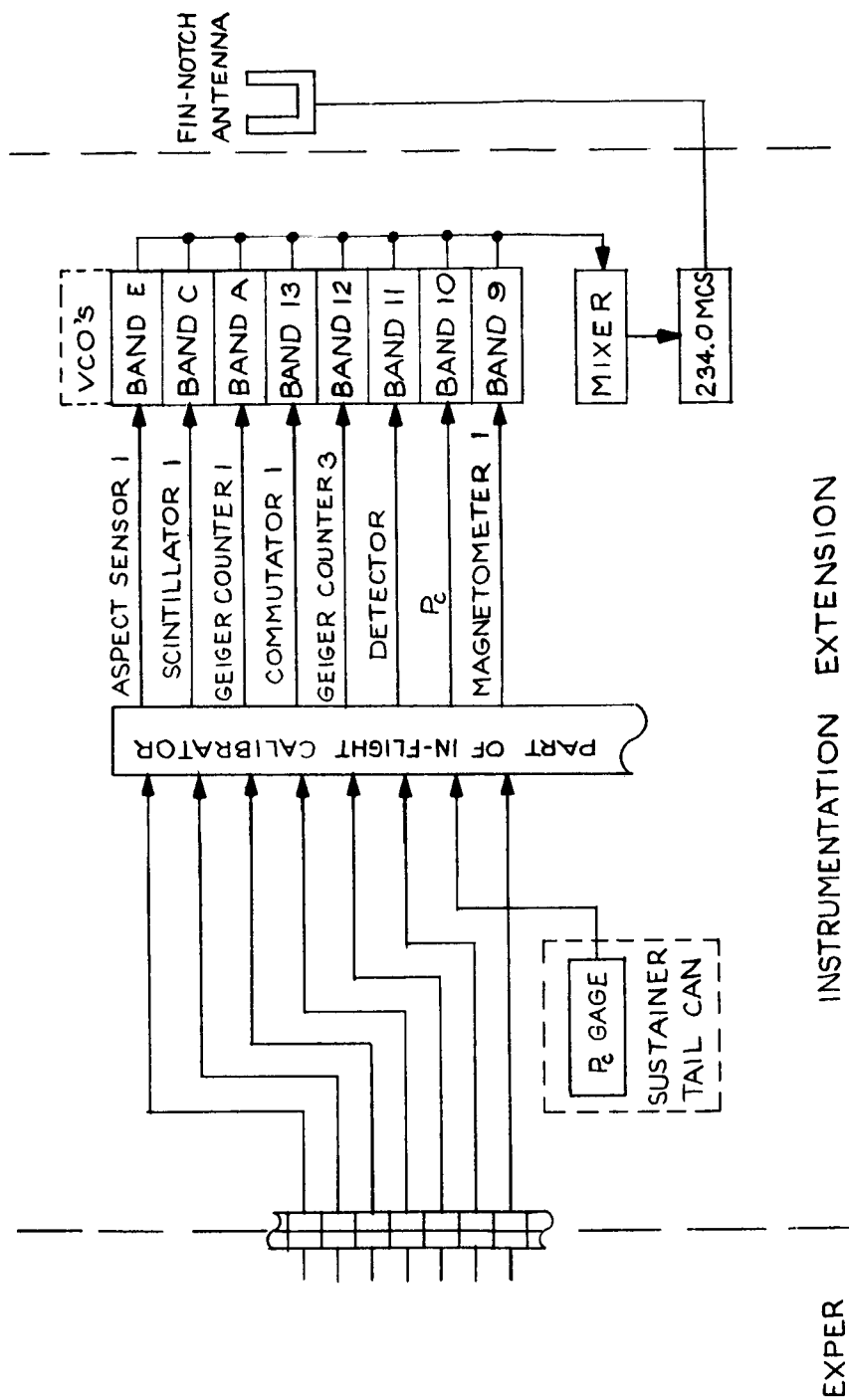


Figure 7 - Telemetry System No. 1 Block Diagram

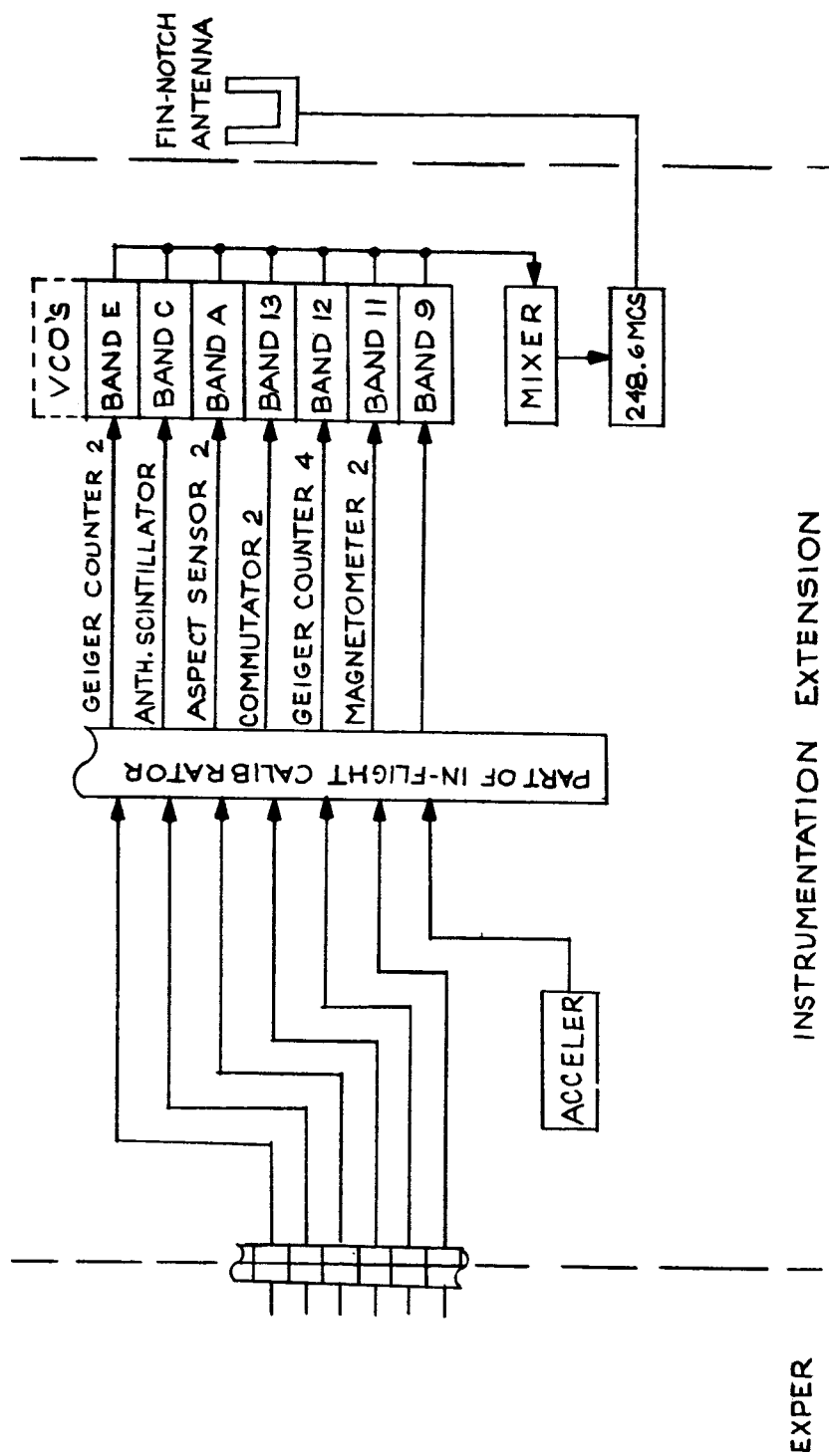


Figure 8 - Telemetry System No. 2 Block Diagram

Table 1. Telemetry Systems 1 and 2 Frequency and IRIG Band
Allocations

FREQ	IRIG BAND	FREQ RESP	TM 1 ALLOCATION	TM 2 ALLOCATIONS
70 kcs	E	2100 kcs	Aspect Sensor #1	Geiger Counter #2
40 kcs	C	1200 kcs	Scintillator #1	Anthracene Scintillator
22 kcs	A	660 kcs	Geiger Counter #1	Aspect Sensor #2
14.5 kcs	13	220 kcs	Commutator #1	Commutator #2
10.5 kcs	12	160 kcs	Geiger Counter #3	Geiger Counter #4
7.35 kcs	11	110 kcs	Photo Electric Detector	Magnetometer #2
5.4 kcs	10	80 kcs	Chamber Pressure (P _c) gage	(not flown)
3.9 kcs	9	60 kcs	Magnetometer #1	Accelerometer
Deviation of IRIG Bands A, C, and E were $\pm 15\%$. Deivation of IRIG Bands 9 through 13 were $\pm 7.5\%$.				

VCO's differed from the standard IRIG narrow-band oscillators used on IRIG bands 9 through 13. Narrow-band VCO's are used when the modulating data does not require the greater frequency response of the wide-band VCO's. Deviation of center frequency of each narrow-band VCO is $\pm 7.5\%$. All VCO outputs in each telemeter system were tied together and applied as a single input to the mixer amplifier which adds all the VCO frequencies. The single output of the mixer amplifier is then used to modulate the FM transmitter, which has an overall center frequency deviation of ± 125 kc/s.

Each telemetry system also consisted of one +6-volt regulator. This device received +30 vdc from the +30V buss and regulated that voltage to the +6V required to operate the VCO's and mixer amplifier. The regulated +6V output was applied to each VCO.

Both payloads carried an in-flight calibrator, which provided periodic system verification of data reference points. In operation, see Figure 9, each data channel was sequentially switched from data to a precision staircase voltage generator, calibrating each VCO input over the range from 0 to +5 vdc in 1-volt increments. In-flight accuracy of the calibrator was within 0.1 percent. When calibration of one channel was completed, that channel was switched back to data, and the next channel was calibrated (approximately 2 seconds were required to calibrate all channels). The calibrator then repeated the sequence approximately 30 seconds later.

The experimenter provided a 45-segment commutator for each telemeter system on both payloads. Commutators were used to provide time-shared experiment information to the telemeter system, where are transmitted to recording ground station. Table 2 provides a listing of commutator segment allocations.

Radio-frequency outputs of both telemeter transmitters were carried through coaxial cables, down the sustainer shroud lines, to the fin-mounted notch antennas, located in fins I and III.

Payload Instrumentation

Design of the overall instrumentation system, as already mentioned, necessitated the use of performance transducers in the Aerobee rocket, to provide the required housekeeping information. To fulfill these requirements, a thrust chamber pressure transducer and a pressure switch were installed in the sustainer

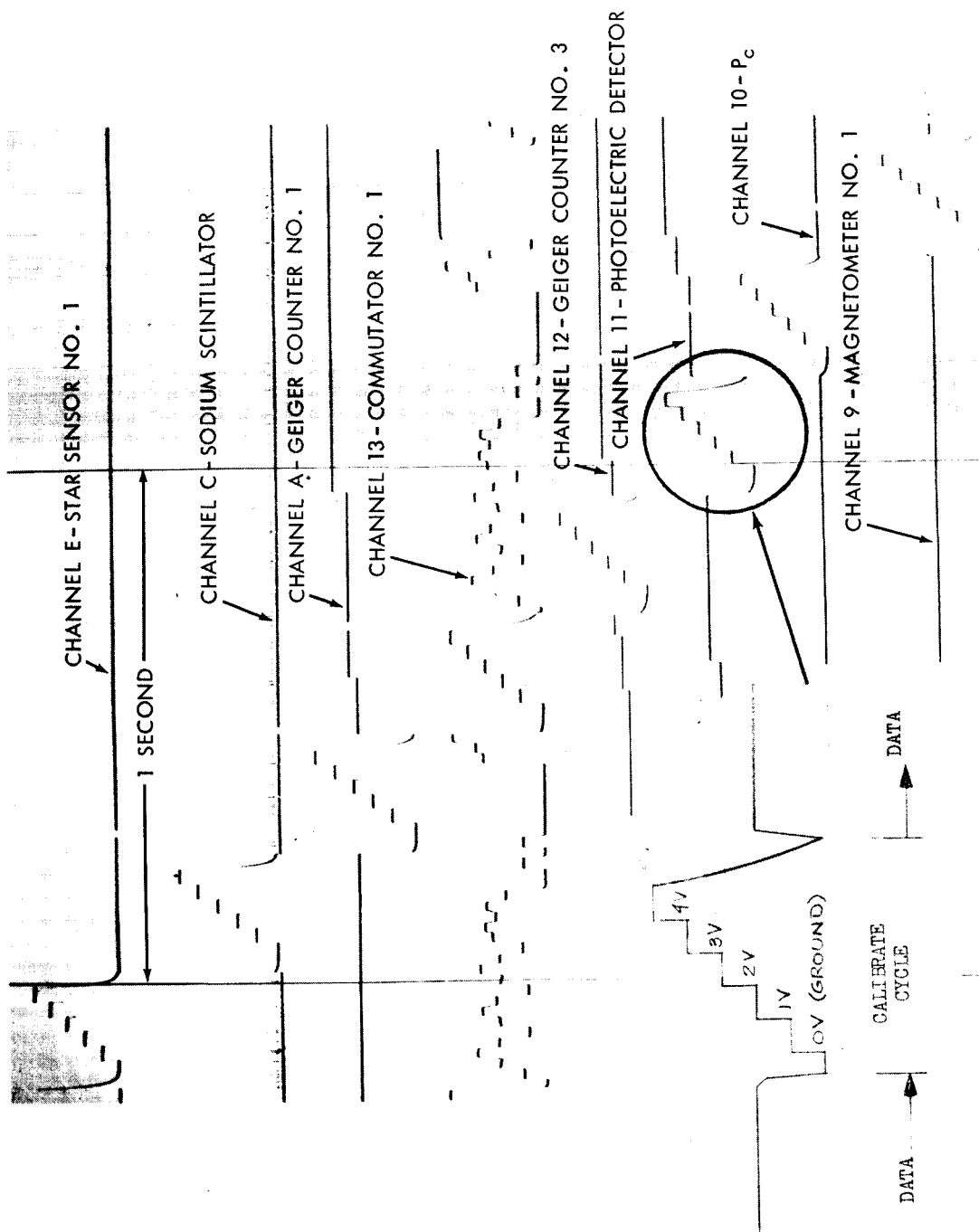


Figure 9 - Calibration Cycle for Flights 4.122 CG and 4.123 CG

Table 2. Commutator Segment Allocations (Sheet 1 of 2)

SEGMENT	COMMUTATOR NO. 1	COMMUTATOR NO. 2
1 - 9	Synchronization Pulse	Synchronization Pulse
10	Spare	Spare
11	Geiger Counter 1, LCRM 1	Star Sensor 1, B+ Mon
12	Geiger Counter 1, LCRM 2	Star Sensor 2, B+ Mon
13	Geiger Counter 1, HV Mon	Star Sensor 1, HV Mon
14	Geiger Counter 1, B+ Mon	Star Sensor 2, HV Mon
15	Geiger Counter 2, LCRM 1	Photo Detector LCRM 1
16	Geiger Counter 2, LCRM 2	Photo Detector LCRM 2
17	Geiger Counter 2, HV Mon	+6.75V Monitor No. 1
18	Geiger Counter 2, B+ Mon	Photo Detector B+ Mon
19	Geiger Counter 3, LCRM 1	Photo Detector 3.5 KV Mon
20	Geiger Counter 3, LCRM 2	Photo Detector 1 KV Mon
21	Geiger Counter 3, HV Mon	Spare
22	Geiger Counter 3, B+ Mon	Photo Detector Door Mon
23	Geiger Counter 4, LCRM 1	Photo Detector Filter 1 Position.
24	Geiger Counter 4, LCRM 2	Photo Detector Filter 2 Position.
25	Geiger Counter 4, HV Mon	Spare
26	Geiger Counter 4, B+ Mon	Sodium Scintillator, HV Mon
27	Geiger Counter PM Tube HV Mon No. 1	Sodium Scintillator, LCRM
28	Geiger Counter PM Tube HV Mon No. 2	Sodium Scintillator, B+ Mon

Table 2. Commutator Segment Allocations (Sheet 2 of 2)

SEGMENT	COMMUTATOR NO. 1	COMMUTATOR NO. 2
29	Spare	Anthracene Scintillator, LCRM
30	Spare	Anthracene Scintillator, B+ Mon
31	Geiger Counter Filter 1, Position 1	Anthracene Scintillator, HV Mon
32	Geiger Counter Filter 1, Position 2	Vacuum Ion Current Monitor
33	Geiger Counter Filter 2, Position 1	Vacuum Ion HV Monitor
34	Geiger Counter Filter 2, Position 2	Vacuum Ion B+ Mon
35	Spare	+6V Filter Battery Monitor
36	Spare	+12V Battery Monitor
37	Spare	+6.75V Monitor No. 2
38	Spare	Timer No. 1 Operate
39	Spare	Timer No. 2 Operate
40	Spare	Door No. 2 Eject
41	+12V Monitor No. 1	Door No. 1 Eject
42	+12V Monitor No. 2	Door No. 3 Eject
43	+5V Calibration	+5V Calibration
44	+2.5V Calibration	+2.5V Calibration
45	0V Calibration	0V Calibration

system. A thrust accelerometer and longitudinal and transverse magnetometers in the recoverable portion of the payload were also provided.

The chamber pressure transducer (also known as a P_c gage) is a resistance device manufactured by Giannini Corp., and was mounted in the sustainer's tail can section. Purpose of this instrument was to measure the chamber pressure in the tail can during sustainer ignition and burning (see Appendix A for the P_c gage response curve).

A helium pressure switch (P_{he}) was mounted in the sustainer's regulator section, and was connected between the valve position monitor switch in the tail can section and the pullaway umbilical, via shroud line 1. Purpose of the P_{he} switch is to monitor the helium pressure prior to launch.

Each of the ASE payloads carried a Giannini, linear, resistance gage accelerometer, which was mounted in the instrumentation extension of both payloads. This device provided acceleration information on both flights for housekeeping purposes (see Appendix A for acceleration response curve). A pressurized, fluid-damped instrument, the Giannini accelerometer measured linear acceleration in a plane perpendicular to the mounting surface and along the major axis of the rocket. Output data is obtained as a resistance and/or voltage ratio by utilizing a spring-supported mass to actuate the wiper arm of a precision potentiometer in direct proportion to the accelerating force.

Longitudinal and transverse magnetometers, providing magnetic aspect data, were supplied by the ASE experimenters, and housed in the experiment section of the payload. Data derived from these transducers were supplied to the telemeter systems via the connector between the experiment and instrumentation extensions.

Also a part of the instrumentation system design was a cutoff/severance distribution box, located in the sustainer's tail can section. Contained in the distribution box were three 20K feet altitude switches and associated circuitry. The altitude switches, when closed and in conjunction with associated circuitry, provided severance voltage to the severance detonator block. Fuel and oxidizer squibs, and their associated circuitry, were armed for propellant cutoff when the tail switch closed, indicating that the booster had separated from the Aerobee sustainer. Propellant cutoff could then be commanded by the Range Safety Officer toning the command transmitter on channels 1 and 5.

Ancillary ground equipment was also a design and fabrication responsibility in support of the celestial X-ray payloads. This equipment consisted of a launch control ground console and pullaway umbilical systems. The pullaway umbilical was located in the blockhouse and was used to check out both payload and rocket. One umbilical cable was installed from the launch control ground console to the blockhouse wall umbilical box. A permanent harness connected the blockhouse to the Aerobee launch tower. The second umbilical cable was connected from the Aerobee launch tower to the payload's umbilical connector in the instrumentation and telemetry extension.

In a separate experiment on "g" reduction timers, two Raymond timer units were flown on the Aerobee 4.122 CG payload only (see Figures 5 and 6), one modified and one unmodified (see Figure 10). Background and results of this experiment are contained in a forthcoming report on instrumentation design techniques of the Sounding Rocket Instrumentation Section.

Purpose of this instrumentation was to evaluate a modification to one "g" reduction timer. The second timer, unmodified, was used as a reference. Outputs from the "g" reduction timers were connected to the experimenter's no. 2 commutator on segments 38 and 39, from which data obtained was telemetered to recording ground stations.

Payload pyrotechnics, designed into the instrumentation system by the Instrumentation Engineer, included first and second severance. First severance was the separation of the payload from the Aerobee sustainer and was accomplished by primer cord installed in the vicinity of the parachute extension's rear bulkhead. Second severance was responsible for deploying the parachute and was accomplished by firing squibs on the parachute recovery package.

TIMER SEQUENCE

Experiment event-time sequence functions were controlled by an experimenter-supplied timer. Timer settings were preset to provide three functions: (1) ogive door ejected at T +76 seconds, (2) experiment instrumentation door ejected at T +99 seconds, and (3) filter squibs fired at T +170 seconds.

Severance circuit design was a requirement in support of the celestial X-ray payloads and was accomplished using severance event-time sequencing. Using a Raymond "g" timer, first severance was programmed to occur at T +414 seconds (approximately 250,000 feet), at which time the payload would be severed from the sustainer (see Figure 11). Shortly thereafter, as the payload descended past 20K feet, pressure sensitive altitude switches closed, blowing the second severance squibs, deploying the parachute for the recovery operation. A special delay timer was used to ensure severance lockout prior to T +65 seconds.

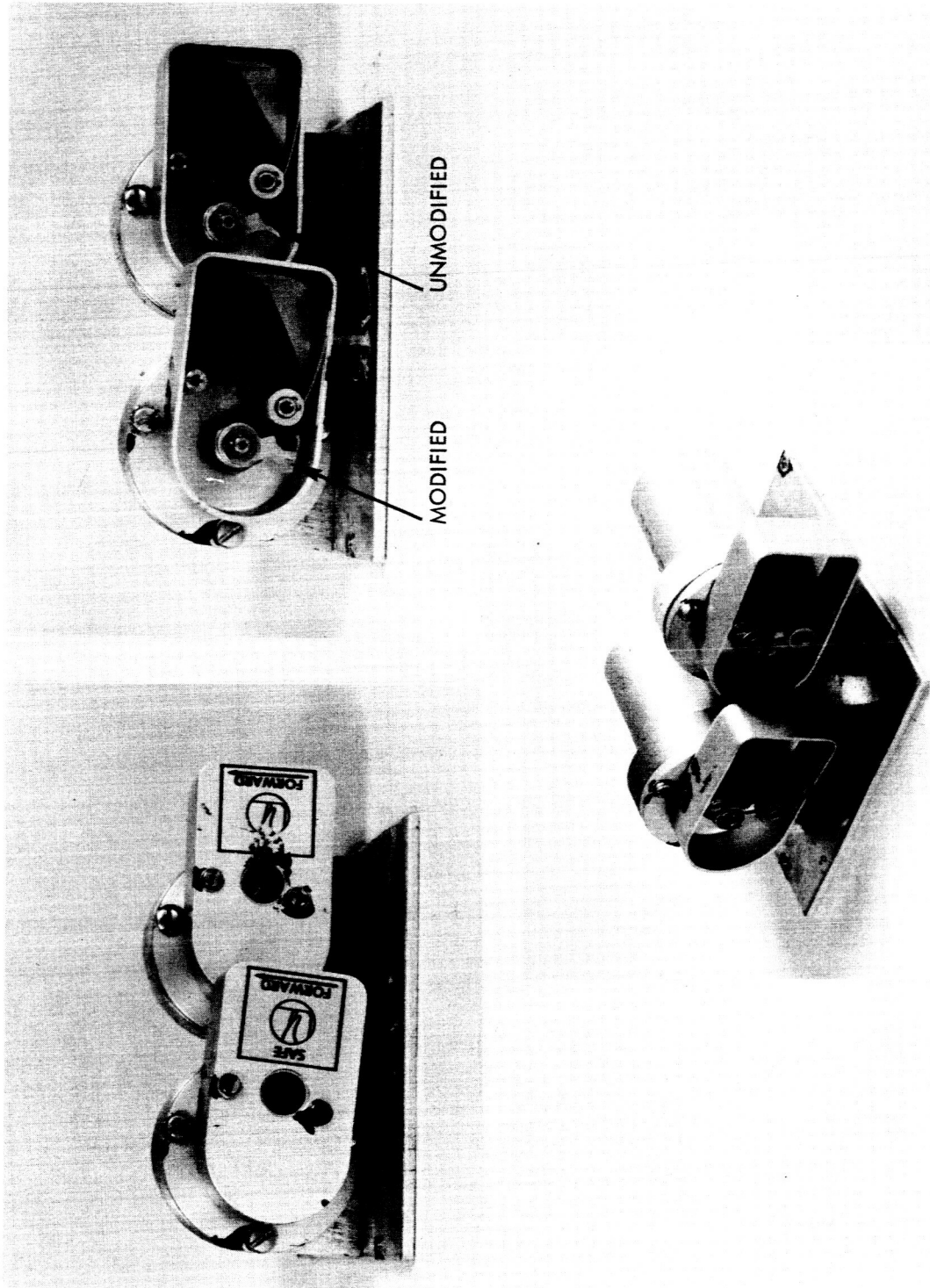


Figure 10 - "G" Reduction Timer Experiment Composite

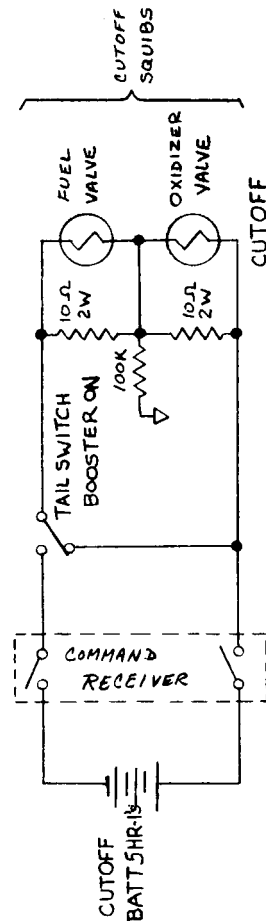
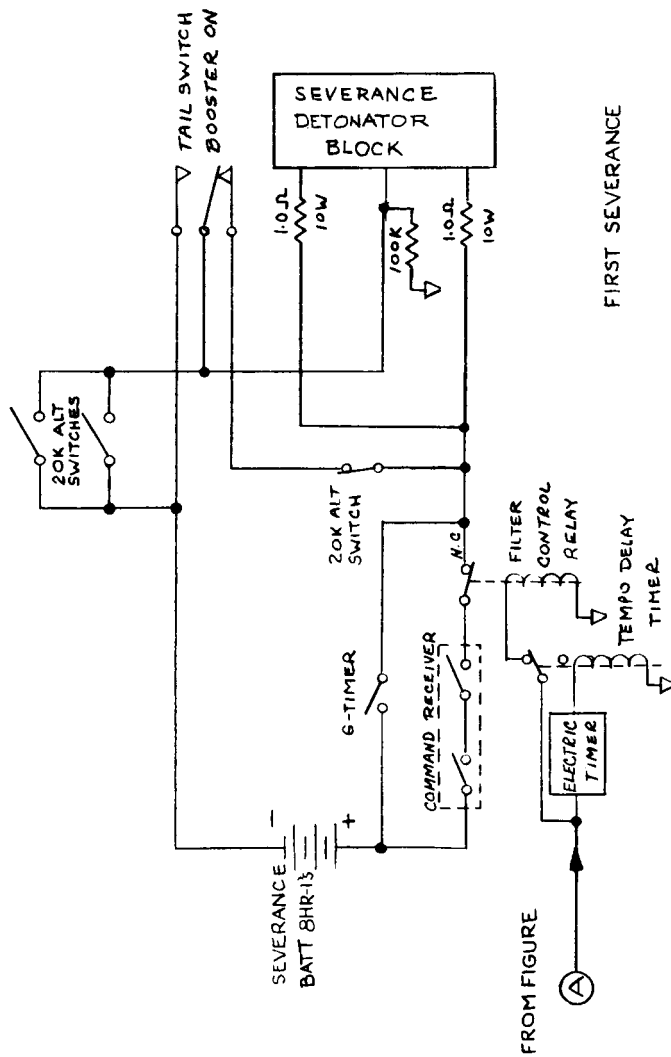


Figure 11 - Cutoff and Severance Squib Circuits

PYROTECHNICS

The experiment contained seven pairs of squibs (see Figure 12) which, when actuated, released the doors on the nose cone for geiger counter and photoelectric detector components' performance. Timing of these events were controlled by primary and back-up "g" timers contained in the experiment's instrumentation. As shown in Figure 12, these timers were controlled by the internal-external power transfer stepper switch.

In addition to the severance circuits discussed under TIMER SEQUENCE, Sounding Rocket Instrumentation Section was responsible for providing sustainer fuel and oxidizer cutoff pyrotechnic circuitry for both payloads. As shown in Figure 11, command receiver channels 1 and 5 closed upon ground command, to provide voltage to fire the cutoff squibs.

INTEGRATION

Integration of the payloads for Flights 4.122 CG and 4.123 CG were held at GSFC's Beltsville Building on 29 and 30 June 1964. During an integration, it is intended that any existing incompatibilities be discovered and remedied prior to shipping the payload to the launch site. During the integration, the component parts of a payload (experiment, instrumentation, nose cone, and pyrotechnics) are both mechanically and electrically mated (integrated) and checked out under simulated flight conditions. It is also at this time that the telemeter systems are checked out by the ground station at the integrating facility (Station G is located in the Beltsville building and has both FM/FM and PPM capabilities), to ensure that telemetry transmitters, VCO's, transducers, and experimental equipment are functioning properly.

No major problems were encountered during the integration of either payload. All telemeter channels received correct data; experiment door squibs actuated as programmed; severance cutoff circuits checked out; and severance lockout systems operated as expected. The only problem encountered was that the connector between the telemeter system and the experiment was damaged during the mating operation, resulting in a broken wire and the loss of IRIG band E on the Aerobee 4.123 CG payload. This malfunction was immediately remedied.

Original plans called for experimental payload vibration checks to be made on 24 and 25 June. This schedule could not be met, therefore, a new date was established using a facility near the experimenters' laboratory.

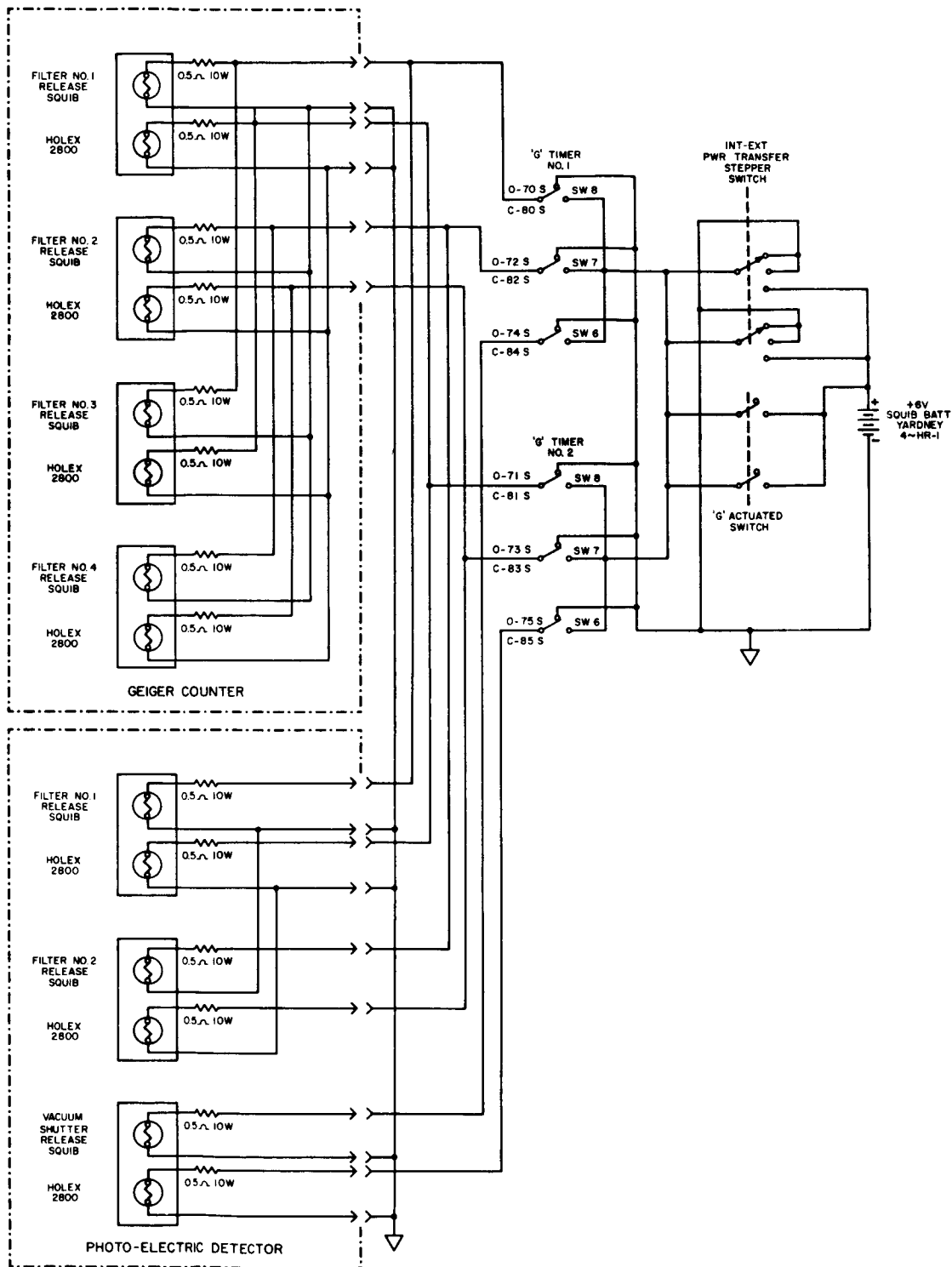


Figure 12 - Experiment Pyrotechnic Circuitry

Original plans called for experimental checks to be made on 24 and 25 June. This schedule could not be met, therefore, a new date was established using a facility near the experimenters' laboratory.

Since a post vibration telemetry/function check could not be made conveniently, the experimenter was requested to make available any information concerning any and all malfunctions that occurred during vibration testing. Vibration checks took place at Raytheon Corporation on 9 and 10 July 1964 with no malfunctions reported.

PRE-LAUNCH OPERATIONS

As a result of the wide difference in launch dates for the ASE payloads, pre-launch operations are subdivided into two parts, one for Flight 4.122 CG and the other for Flight 4.123 CG.

FLIGHT 4.122 CG

Personnel arrived and reported on board WSMR on 23 July 1964. New Mexico State University (NMSU) personnel assisted in rocket wiring of the Pc gage, tail distribution box, and associated telemetry airborne antennas, in the sustainer's tail can section.

At this time, the parachute detonator box was inspected and the nickel cadmium batteries were found to be leaking electrolyte. A request was initiated to GSFC Beltsville for three spare batteries.

Telemetry requirements for this payload were for two FM/FM antennas and a command receiver antenna, all fin mounted. Since most Aerobee 150's have only fins two and three modified for notch antennas, it was necessary to substitute Flight 4.122 CG's fin I for another Aerobee fin with antenna capability. In addition, it was necessary to modify the sustainer's forward skirt. To accomplish this requirement, a hole was drilled in the vicinity of the 19-pin tail wiring connector in the forward skirt. A rubber grommet was inserted in the hole and the rf cable connected from the telemeter antenna on fin I, through the length of shroud 1, inserted through the grommet into the forward skirt, and connected to the BNC-type coaxial fitting on the parachute recovery extension bulkhead.

Between 24 and 27 July, payload and sustainer build-up and checkout continued. Nickel-cadmium batteries were taken from a previous WSMR-launched vehicle and checked for possible emergency use on this payload. The helium pressure switch and "g" timer were mounted in the forward skirt. Two "g" reduction timers, one of which was modified (see Figure 12 and the report on the modification of the "g" reduction timer in the forthcoming report on instrumentation design techniques) were installed in the instrumentation extension.

The R-420A command receiver was received from Missile Flight Safety and was installed in the forward skirt bulkhead. Space General Corporation personnel received the parachute recovery extension from Sounding Rocket Instrumentation Section for packing and installation of the prima cord and shape charges. This operation was assisted by Sounding Rocket Instrumentation Section personnel.

Horizontal, vertical, and launch schedules were decided upon and the countdown procedures confirmed (see Appendix B for countdown procedures used in the integration, horizontal and vertical tests, and the actual launch).

The experimenter requested that data from the two telemeter systems be recorded on one photographic paper record. This request was made to the Range and approval was granted.

Pre-horizontal checks were conducted with good results. Some noise was evidenced on the C and E IRIG bands. Noise was determined to be a ground station error in that proper output frequency filters were not available.

On 28 July, the horizontal check was performed from 1000 to 1100 with all units reporting operable on time. Three telemetry ground stations were covering the horizontal check: GSFC's mobile ground station D, monitoring 234.0 mc/s and 248.6 mc/s; WSMR's mobile ground station J-5, also monitoring 234.0 mc/s and 248.6 mc/s; and NMSU's portable ground station, monitoring on 234.0 mc/s only.

Results of the horizontal check were satisfactory. Signals were received properly with no evidence of noise (which was evident on the preceding day). One experiment did fail to blow off. Investigation proved it to be caused by a non-connected plug in the experimenter's section.

Upon completion of the horizontal test, the telemetry ON/OFF relay failed to respond to the OFF command. Replacement of the relay corrected the malfunction.

Range Safety obtained satisfactory results during the horizontal tests. Cutoff functioned when toned and the severance circuit was locked out for the required 65 seconds. The severance back-up "g" timer actuated at 420 seconds. Following the horizontal test, the payload was weighed and spin balanced. Additional weighting of the payload required that the "g" timer be reset from 420 seconds to 398 seconds.

Parachute actuator batteries were charged and the system placed in a Pressure Bell Jar. One ampere fuses simulated squibs. The system fired at 17,000 feet. Batteries were then recharged.

Flight 4.122 CG was installed in the tower on 29 July (see Figures 13 through 15). Pullaway leads on cables P1, P2, and P3 were checked. P1 was to be used by NMSU, P2 by Sounding Rocket Instrumentation Section, and P3 by the ASE experimenters. Pullaway checks revealed that wires 11 and 12 in P1 were reversed. This problem was corrected.

The blockhouse console was installed and power was supplied to the tower through connecting cables. External power to the tower was set at 30.0 vdc. A severance "g" timer check was taken and it was noted that the unit timed out at T + 398.0 seconds.

On 30 July, Range Safety cleared severance/cutoff circuitry. Severance was planned for T + 400 seconds via the "g" timer; severance signals were locked out until T + 65 seconds, via the delay timer.

The vertical check commenced at 1025 and was completed successfully after a minor time delay due to difficulties in removing tail can doors. Telemetry signals were recorded by GSFC and WSMR mobile ground stations and the NMSU portable ground station, as before.

Internal battery voltages were noted to be at 31.0 vdc. External calibrate was actuated at T -13 seconds. NMSU personnel removed the severance/cutoff flight batteries in order to install flight batteries prior to the 5-hour check. Instrumentation was not altered following the vertical check.

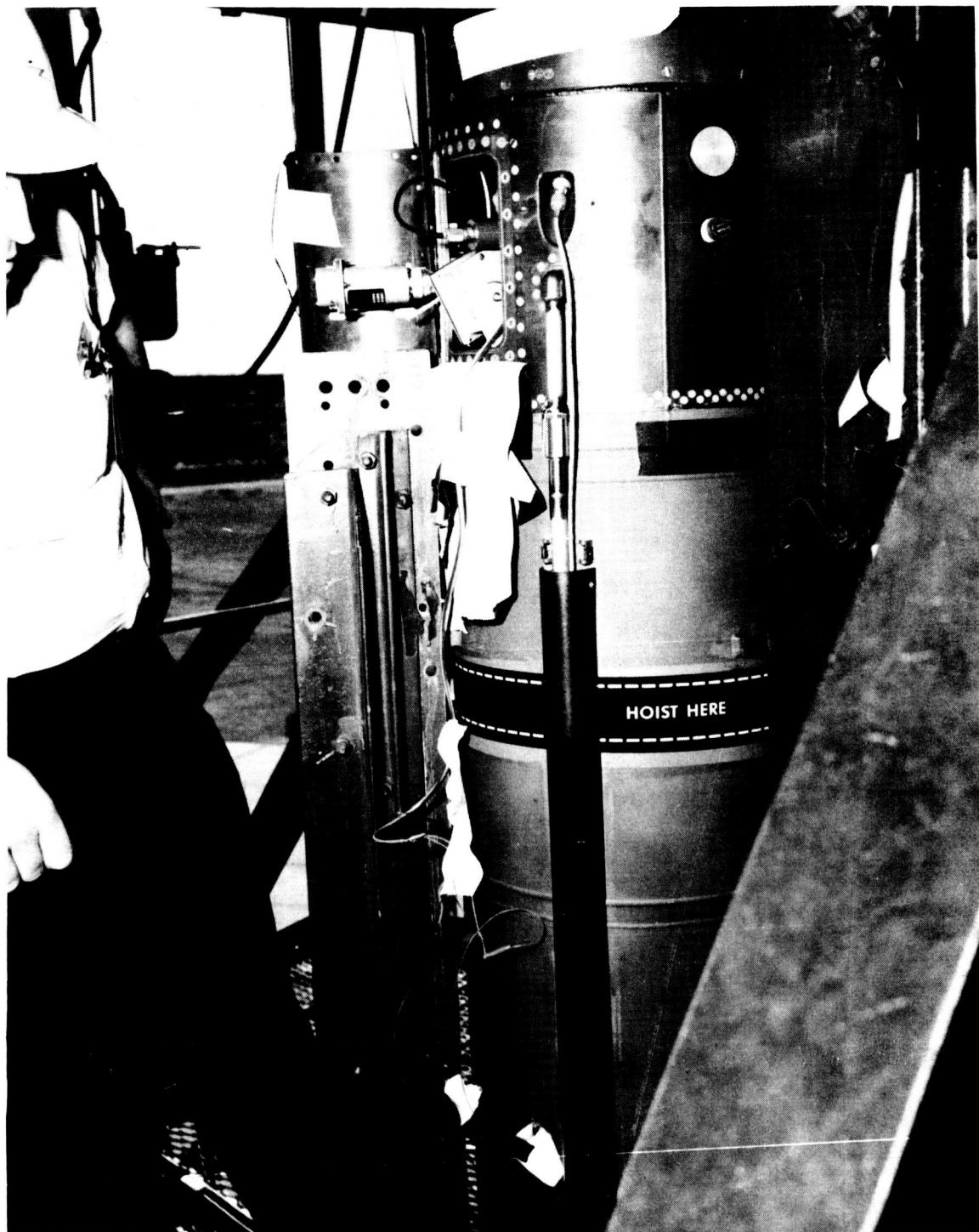


Figure 13 - Flight 4.122 CG During Vertical Checkout

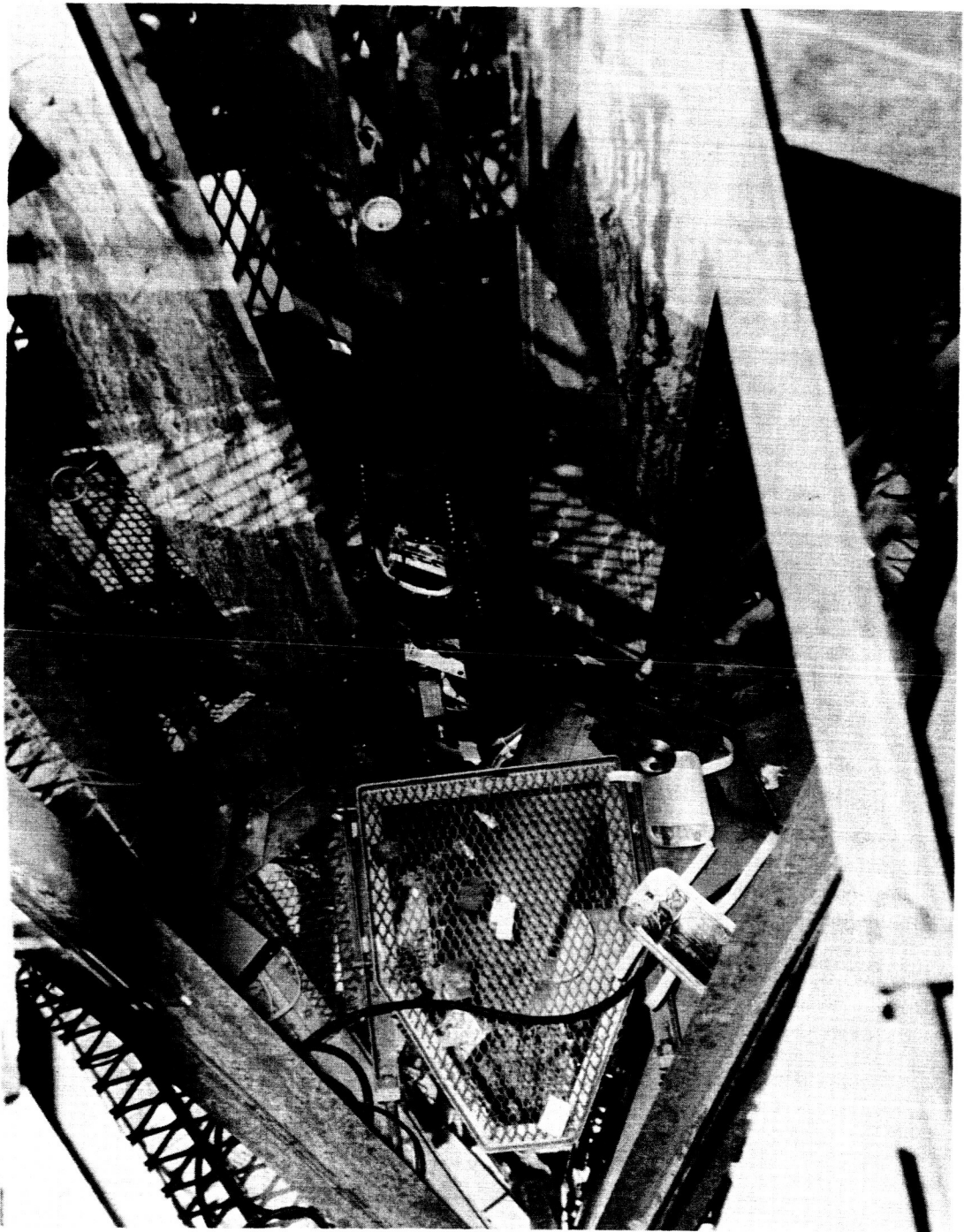


Figure 14 -Flight 4.122 CG in the Tower

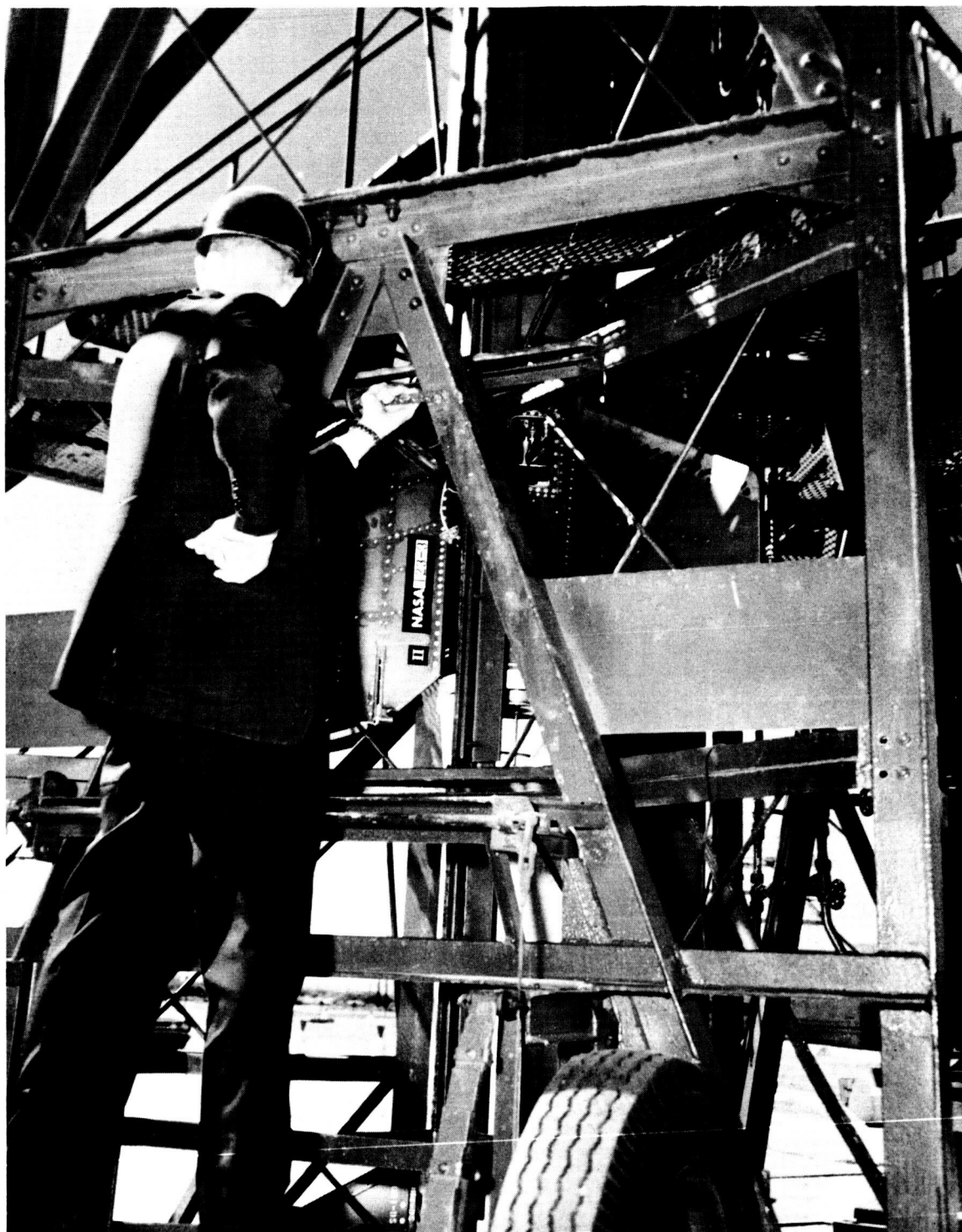


Figure 15 - Payload Undergoing Range Safety Checks

On 31 July, the T -5 hour checks were successfully conducted. Battery voltages were noted to be 29.5 vdc; propellant shutoff valve monitors were measured at 1000 ohms; 5v regulator monitor, 1.7-amp panel current, and severance lines all checked out satisfactorily. Instrumentation and telemetry were turned ON internally at T-2 minutes. A rocket misfire occurred and telemetry was left on internal power for 3 additional minutes.

A second launch attempt was immediately made, but the rocket again failed to ignite. Battery time was recorded as 130 seconds. Further launch attempts were temporarily cancelled. The rocket was disarmed and depressurized before personnel were allowed to enter the tower complex to conduct checks. The launch crew certified the firing lines as satisfactory. Space General Corp. personnel tested the take-off squib (flare) and measured 1 ohm. This measurement was satisfactory. Rocket firing lines were checked next. Upon removing the door of the firing line distribution box, water was noted to run out. Complete removal of the door showed wet sand about 2 inches deep inside the box. At this time, the instrumentation engineer was informed that the tower had been sandblasted the previous week.

A complete circuit check was made with the squib outside the Aerobee, and the squib fired. No positive answer for the no-fire condition has been made, other than the low resistance short possibility resulting from the water-soaked sand in the firing line distribution box.

On 1 August, the launch was rescheduled for 4 August, then later that day, rescheduled for 7 August. All flight batteries were removed and charged. Parachute actuator box was removed and its batteries inspected.

On 6 August, the severance "g" timer was checked. Checks showed the "g" timer timed out at 402, 399, and 403 seconds. A brief turn-on was requested at 1100. Satisfactory operation of all systems were verified at that time.

On 7 August, the instrumentation and telemetry checks were conducted at T -10 hours. Battery voltage was measured at 30.5 vdc. Instrumentation was turned ON for 10 minutes. At T -5 hours, the battery voltage was again checked, reading 30.5 vdc. Instrumentation was turned on for 7 minutes. At T -6 minutes, the countdown was held due to unfavorable weather conditions. The hold condition degenerated to a Standby condition at 2116. At 2200, the valve switch monitor was

noted to measure 1000 ohms. Radar and weather problems necessitated cancellation of the launch at 2325. Launching of the flight was rescheduled for 28 August 1964.

On 28 August 1964, preliminary checks were conducted satisfactorily. Flight 4.122 CG was successfully launched without further incident. Severance was commanded at 250,000 feet and telemetry splash was recorded at 375.6 seconds. Early severance was a result of vehicle underperformance. Negligible telemetry dropouts were noted on the ground station recordings.

FLIGHT 4.123 CG

Sounding Rocket Instrumentation Section personnel arrived at the WSMR launch facility on 15 October 1964 for build-up and checkout of the payload. During the time commencing with the arrival of Sounding Rocket Instrumentation Section personnel at WSMR through to the 26th of October, the payload was checked out (see Figure 16) and mated to the sustainer.

The rf carrier output of the second telemetry transmitter (248.6 mc/s) was noted to drop out between 29 and 30 vdc. At these points, the rf voltage output of the transmitter dropped to approximately zero. Output of the Yardney HR-1 DC Silvercel batteries are normally 28.5 to 30.5 vdc following normal preload checks. Since the critical dropout point of the transmitter and the plateau voltage range of the batteries were directly connected, the transmitter was replaced by a spare unit. The new transmitter was checked out by setting up a pre-emphasis test, using the pre-emphasis data obtained at GSFC.

Severance times were rechecked after payload weigh-in. The timers were then reset. A complete checkout of connecting lines between the launch tower and the blockhouse was conducted. These checks included continuity, megger checks (high impedance across lines), and voltage checks in the tower. Following these checks, the payload was prepared for pre-flight checks (horizontal and vertical). Altitude switch performance for parachute actuation was ensured by firing the actuator in a Bell Jar, indicating performance of the components at the prescribed altitude. A telemetry check was made through the NASA mobile telemetry trailer, Station D, checking VCO bandedges and deviation. The helium pressure switch was checked prior to installing the rocket



Figure 16 - Flight 4.123 CG Undergoing Ground Checks

in the tower. Helium pressure was noted to be approximately 3000 psi.

Horizontal and vertical checks were conducted successfully without problems. Flight 4.123 CG was launched without incident on 27 October 1964 at 0058Z (Greenwich Mean Time). Rocket and telemetry performance was good, with 393 seconds of telemetry received. Payload severance occurred at T + 393 seconds, at an altitude of 250,000 feet, upon ground control's command.

SUPPORTING GROUND STATIONS

Ground station support for both ASE payloads was provided by GSFC's Mobile Ground Station D, WSMR's Mobile Ground Station J-5, and NMSU's portable ground station. Table 3 provides a list of ground station recording track assignments, as outlined in the flight plan. The WSMR ground station, J-5, was requested to record data from the horizontal, vertical, and flight launching on 1/2-inch magnetic tape at the standard IRIG speed of 60 ips. Real time paper records from the magnetic oscillographs were requested on 12-inch wide, permanent process paper. Ground station magnetic oscillographs were to be run at 6.4 ips. Galvanometer deflections were to be set for maximum signal.

Recording tape distribution included: (1) original tapes and one palyback record was to be sent to the Instrumentation Engineer, (2) one real time paper record from each station was to be delivered to the Project Scientist directly after launch, (3) three copies of each frequency from the best recording station and one copy of each frequency from each of the other recording stations were to be sent to ASE, and (4) one copy each from the best recording station was to be sent to other sections of GSFC's Sounding Rocket Branch.

CONCLUSION

Preliminary indications of the flight of Aerobee 4.122 CG were that good experimental data were collected. From a quick-look evaluation, preliminary indications of the flight of Aerobee 4.123 CG indicated that the experiment was a success. Additional indications are that the photo detector, which provided marginal performance on Flight 4.122 CG, operated satisfactorily during Flight 4.123 CG.

Table 3. Ground Station Track Assignments

TRACK	ASSIGNMENT NO. 1	ASSIGNMENT NO. 2
1	Voice countdown	Voice countdown
2	234.0 mcs video, main rcvr	248.6 mcs video, main rcvr.
3	234.0 mcs signal strength, Main receiver	248.6 mcs signal strength, Main Receiver
4	234.0 mcs video, back-up receiver	248.6 mcs video, back-up receiver
5	234.0 mcs signal strength, Back-up receiver	248.6 mcs signal strength, Back-up receiver
6	100 kcs reference signal and WSMR Timing (B)	100 kcs reference signal and WSMR timing (B)
7	17 kcs Servo signal and WSMR timing (E)	17 kcs Servo signal and WSMR timing (E)

In a letter dated 23 December 1964, American Science and Engineering, Inc., provided a summary of the performance of the ASE experimental payloads. Data, as reduced by ASE, indicated that approximately 300 seconds of good data were obtained from Flight 4.122 CG while the rocket was above the atmosphere. As a result of an electronic malfunction, the photoelectric detector did not yield any data. Similarly, because of high voltage breakdown, some geiger counter data was lost. On the whole, ASE recovered most of the data from Flight 4.122 CG and the bulk of the experimental aims were accomplished. Flight 4.123 CG scanned the same region of the sky as its predecessor, but with much higher angular resolution and, since no electronic or mechanical malfunctions occurred, virtually all possible data were recovered.

The ASE letter also indicated that the spin period increased with time on Flight 4.122 CG, but decreased (i.e., spun faster) during the flight of 4.123 CG.

ASE noted that one serious problem did arise on both flights. One photoelectric detector encountered electronic interference from the time power was turned ON during the pre-launch countdown (approximately T -5 minutes) through the launch; however, no interference was observed during the pre-launch activities. The detector failed during the first flight, preventing ASE from ascertaining the cause of failure; however, on the second flight (4.123 CG), the interference disappeared after about 30 seconds of flight and the detector yielded good data for the remainder of the flight. It appears, therefore, that some equipment (e.g., radar) was transmitting during launch and was not transmitting during pre-launch tests, and this caused the interference.

A letter, pertaining to the interference problem on these payloads, was sent to WSMR from Sounding Rocket Instrumentation Section, on 12 January 1965. The letter indicated the undesirability of first turning on the FPS-16 tracking radar at -5 minutes in the launch countdown without prior checking for possible radar interference with the airborne experiment during the vertical test. Sounding Rocket Instrumentation Section requested that Range personnel conduct a radar illumination check during the vertical tests for all future NASA sounding rockets. The Section also indicated that further checks or modified radar operation during launch may be requested as a result of interference during the vertical checks.

APPENDIX A

PERFORMANCE TRANSDUCER RESPONSE CURVES

This appendix contains calibration response curves for the Giannini accelerometers and pressure transducers flown on both Aerobee payloads. These curves were generated from manufacturer supplied data.

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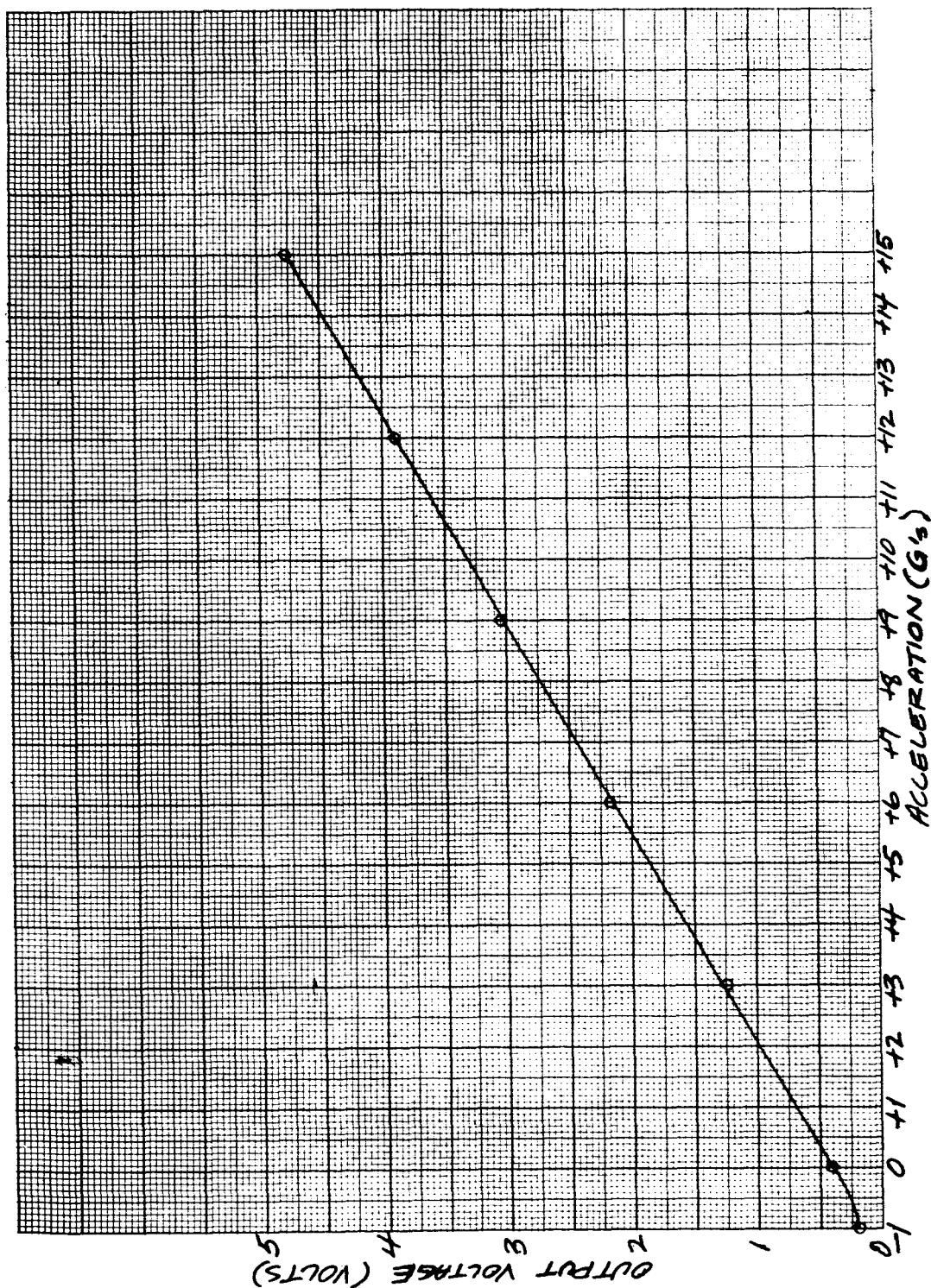


Figure A-1 - Accelerometer Model No. 24117NN-1/15-20 Flight 4.122 CG
(S/N 380-19) Response Curve

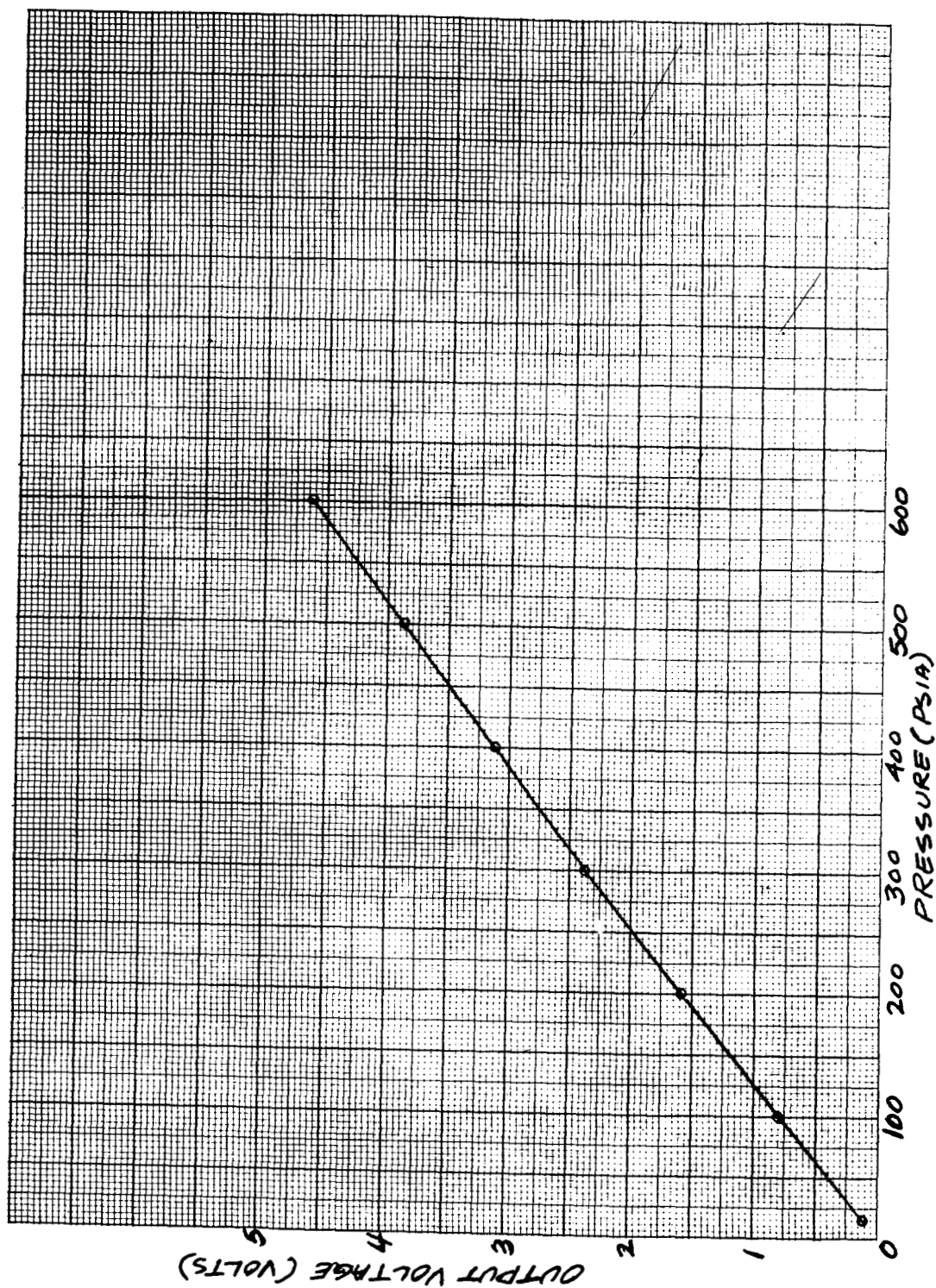


Figure A-2 - Pressure Transducer Model No. A-1.5/60-20 Flight 4.122 CG
(S/N 284-16) Response Curve

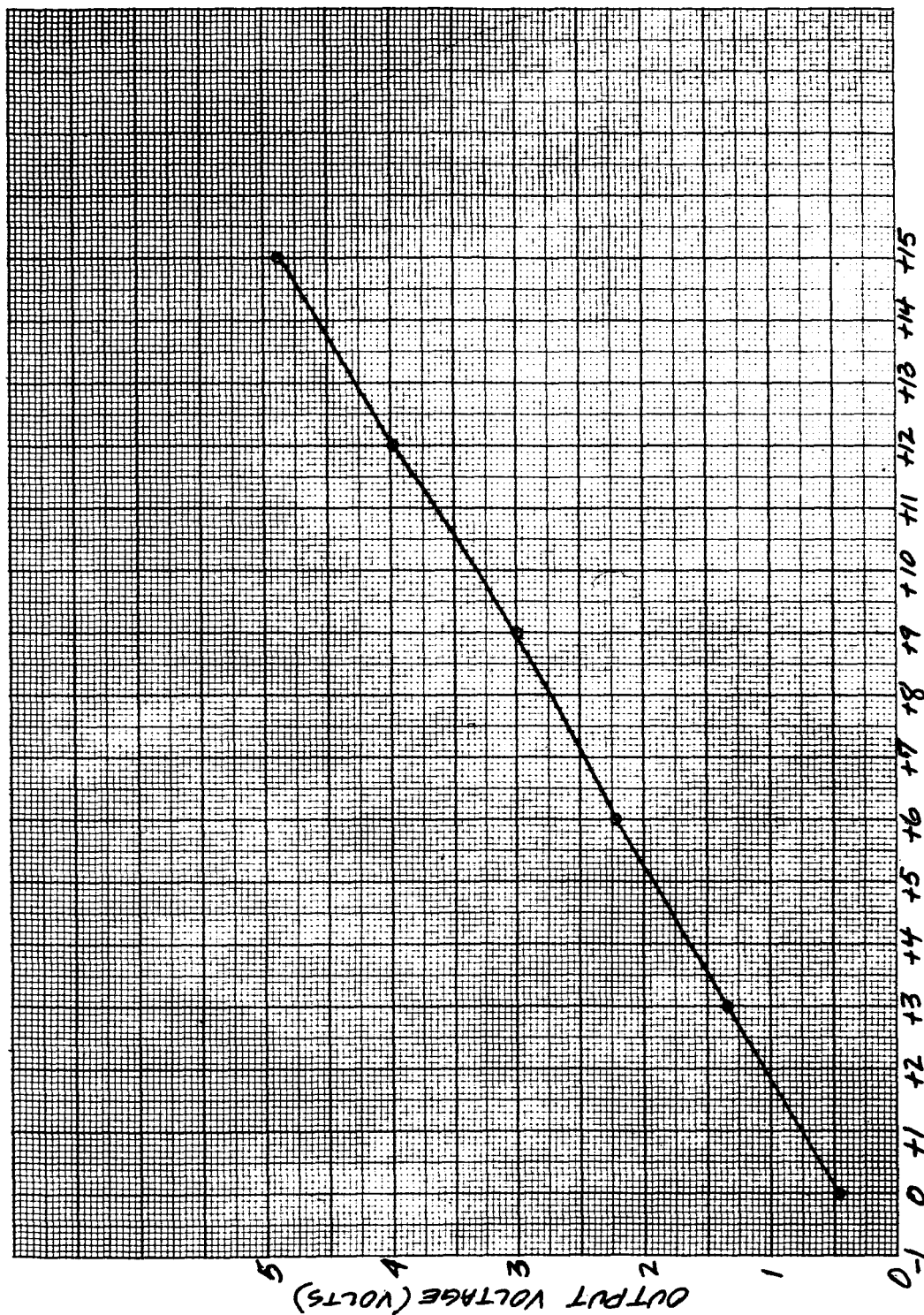


Figure A-3 - Accelerometer Model No. 24117NN-1/15-20 Flight 4.123 CG
(S/N 380-12) Response Curve

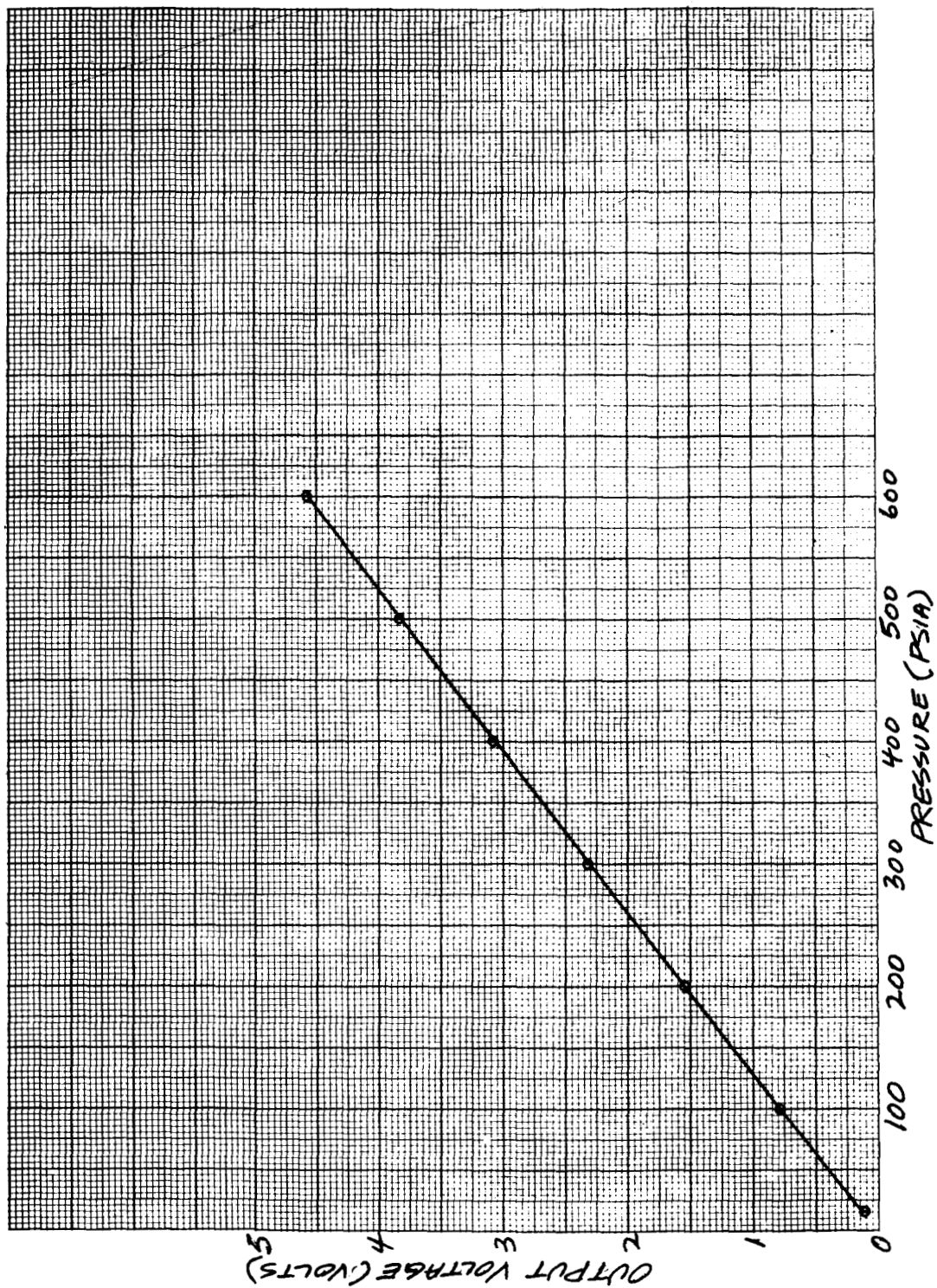


Figure A-4 - Pressure Transducer Model No. A-1.5 / 60 - 20 Flight 4.123 CG
(S/N 284 - 16) Response Curve

APPENDIX B

COUNTDOWN PROCEDURE CHECKSHEETS

This appendix contains the checksheets used in the integration, horizontal and vertical checkouts.

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<u>TIME</u>	<u>FUNCTION</u>
X -30 min	Preliminary System Test: Telemetry on External Power
- 15 min	All plugs and components plugged in and checked.
-10 min	Ground Station Ready
- 5 min	Instrumentation and Telemetry on External Power
-4 min	Valve and P _{he} Monitor Check
	"g" Switch Check
	"g" Timer Check
	Booster Switch ON
-3 min	Range Safety Command Receiver Ready
-2 min	Instrumentation and Telemetry on Internal Power
	Battery Check
	External Power OFF
-30 sec	Telemetry Records on 1"/sec
-15 sec	Telemetry Recorders on 10"/sec
	Calibrate External
0	Pullaway Out
	"g" Timer Tripped (Horizontal Only)
	"g" Switch Tripped (Horizontal Only)
	Gravity Switch Tripped
+3 sec	Booster Switch OFF
+20 sec	Valve Simulator Switch Closed
+30 sec	Command Cutoff (R-420A) Light ON
+35 sec	Depress Tail Switch Light OFF
+40 sec	Command Severance (No Lights)
+65 sec	Command Severance Light ON
+76 sec	Ogive Doors OFF
+99 sec	Instrumentation Doors Open
+170 sec	Filter Squibs; Activate P.E. and Magnetometer
+200 sec	Activate 10° G.T.
+230 sec	Activate 20° G.T.
+260 sec	Activate 30° G.T.
+290 sec	Activate 40° G.T.
+320 sec	Activate Sodium Scintillator

	<u>TIME</u>	<u>FUNCTION</u>
X	+350 sec	Activate Anthracine Scintillator
	+380 sec	Activate Aspect #1
	+395 sec	Activate Aspect #2
	+410 sec	Severance ("g" timer) light ON
	+415 sec	Pullaways IN
		Reset "g" switch
		Reset "g" Timers
		Recorders Calibrate and OFF
		Power to External
		Power OFF
		Record Battery Time